LETTER REPORT

MISHAP TREND ANALYSIS REGARDING MAINTENANCE COMPLIANCE AND DISCIPLINE

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BACKGROUND: During the LGM Conference of 22 - 23 Jan 97, MAJCOM LGMs expressed concerns with the possibility of problems with compliance and discipline. While no specific trends were identified, an independent study was recommended to determine the validity of their concerns.

PROBLEM STATEMENT: HQ USAF/ILM requested that the AFLMA review Class A through Class C mishaps from the last three years and report any significant trends.

OBJECTIVES: HQ USAF/ILM requested the AFLMA consider and report on the following:

- Categories of mishap causal factors,
- Problem trends by sub-system,
- How mishaps, categories, and trends compare with previous years, and
- Recommendations.

METHODOLOGY: We examined a series of aircraft mishap rates for the last four years. Specific analyses included:

- Overall Air Force Class A, B, and C mishap rate
- Maintenance-related Class A, B, and C mishap rate by: DTIC QUALITY INSPECTED 4
    - Causal factors
    - Aircraft subsystems
    - Weapon systems
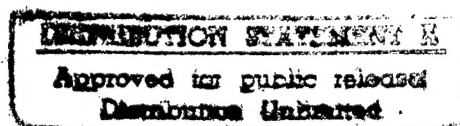
Specific trend analyses were related to flying hours where appropriate to remove operations tempo as a potential contributing cause of changing numbers of mishaps.

The Air Force Safety Center Data Operations and Analysis Division provided the data for this study. Available data included counts by fiscal year (FY93 to present) of various categories of mishaps as well as flying hours. Subsystem data by aircraft was not available.

RESULTS: This section of the report presents the results of applying the methodology described above. Figure 1 compares overall Air Force mishap rates (per 100,000 flying hours) and corresponding maintenance-related (MNX) mishap rates (Class A, B, and C combined). Figure 2 provides a more detailed breakdown of the maintenance-related mishap rates.
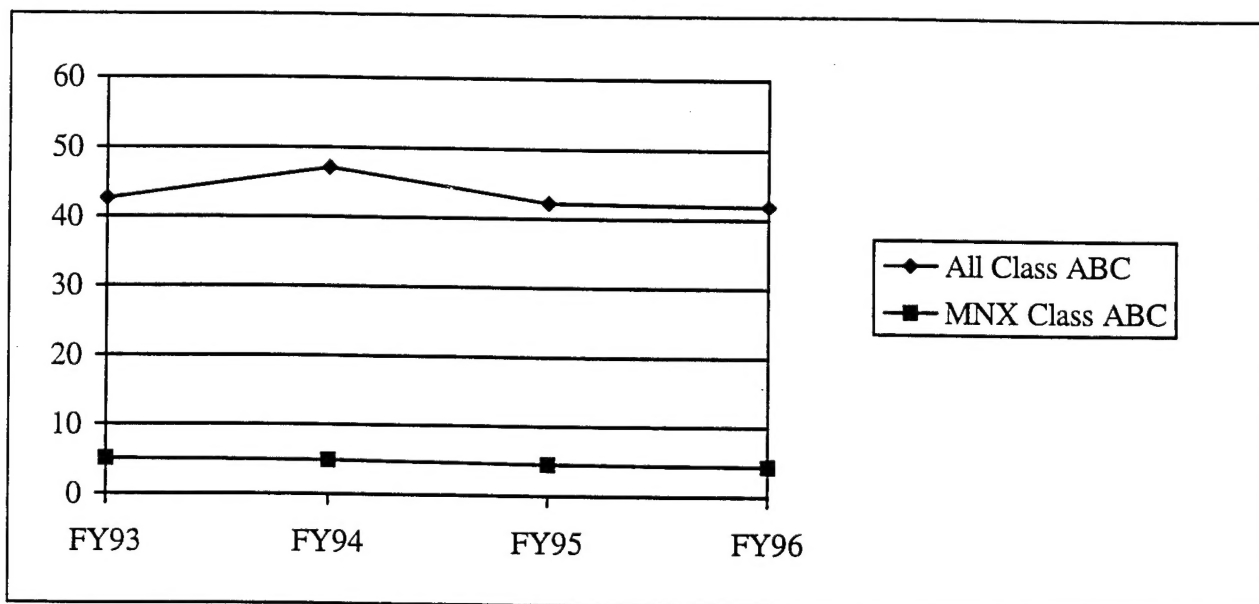

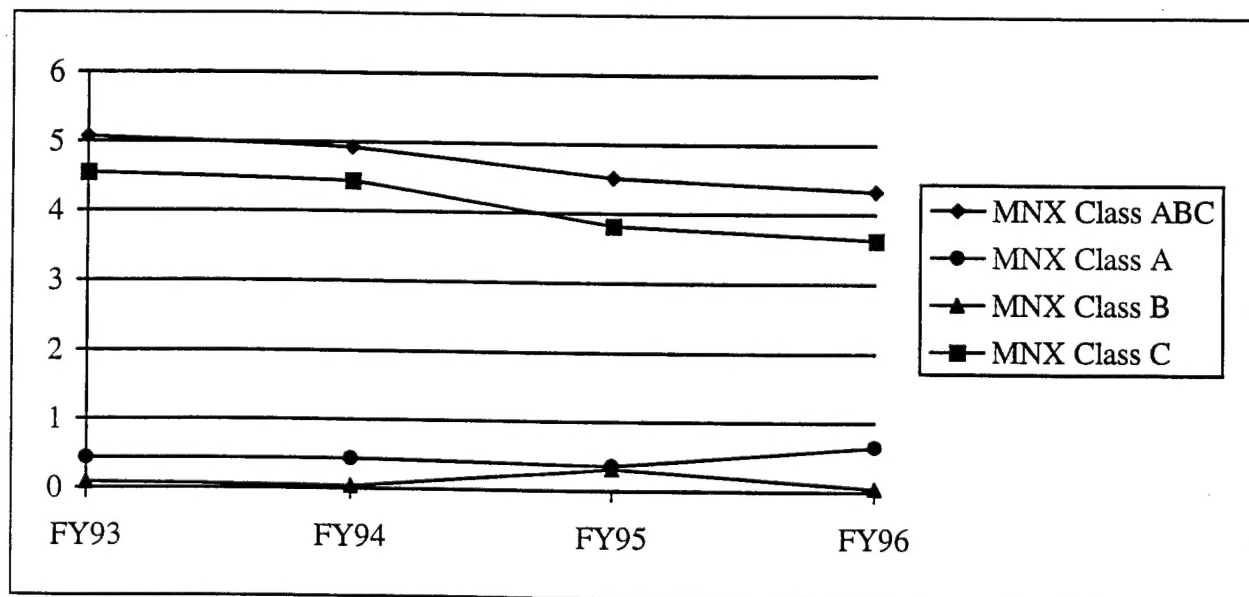**Figure 1 - Maintenance Mishap Rates vs. Air Force Mishap Rates**

Figure 2 - Maintenance Mishap Rates by Class

From figure 1, we see that the maintenance-related mishap rate is only a small portion of the overall Air Force mishap rate. Additionally, we see that the maintenance-related mishap rate appears to be stable and decreasing. From figure 2, we see a rise in the Class A maintenance-related mishap rate from FY95 to FY96. However, no trend can be verified with a single data point. More to the point, this rise in the Class A maintenance-related mishap rate does not drive a corresponding increase in the overall maintenance-related mishap rate.

As requested by the sponsor, we performed a more detailed examination of the overall maintenance-related mishap rate. We decomposed this rate with respect to causal factors and subsystems, as well as by aircraft. (Refer to Appendix A for a complete listing of causal factors, subsystems, and aircraft.) With these time series data, we identified specific categories as having an upward or downward trend to a 95% confidence level by fitting a line to the each category's annual data, and then applying appropriate statistical tests to determine if the line's slope significantly differed from zero (a slope of zero would indicate no trend). Since our analysis was based on an extremely small sample size (4data points), the reader should use caution in interpreting the results.

- Overall maintenance mishaps show a downward trend.
- Categories of Discipline, Other/Unknown Reasons, Structure, and F-16 show a downward trend.
- Categories of Part and T-37 show an increasing trend.
- No other categories showed significantly changing trends.

A detailed account of the statistical analysis is provided in Appendix B.

CONCLUSIONS: The evidence does not support the perception that there are problems with maintenance compliance and discipline.

RECOMMENDATIONS: None.

DISTRIBUTION: Refer to attached Standard Form 298.

APPENDIX A

CATEGORIES OF MISHAPS

Possible categories of mishaps determined by the Air Force Safety Center, are given below:

Causal Factors: Acquisition, Animal, Anthropometry, Attrition, Background (Habit), Complacency, Design, Discipline, Drug/Medication, Inadequate Risk Assessment, Judgment, Manning, Inadequate Corrective Action, Other, Equipment Aging/Malf, Part, Pathological, Perceptions, Physiological, Preparations, Accepted, Proficiency, Psychological, Publication, Inadequate (Training), Unauthorized, Unknown, Weather.

Subsystems: Additional Codes, A/C Fuel System, A.C Structures, Birdstrikes, Bleed Air, Cargo Drop, Collison W/ Ground Non-Range, Collison W/Ground Range, Comm/Nav, Electrical, Engine Failure, Facilities, Flight Controls, Flight Instruments, Hydraulics/Pneumatics, Landing Gear Failures, Midair Collisions, Pilot Induced Control Loss, Pilot Induced Flameouts, Pilot Induced Landing Accident, Pilot Induced Takeoff Accident, Propellers, Tests, Undetermined/Misc, Weather

Weapon Systems: A-6, A-7, A-10, A-37, B-1, B-2, B-52, C-5, C-9, C-10, C-12, C-17, C-18, C-20, C-21, C-23, C-26, C-27, C-130, C-135, C-137, C-141, C-172, C-212, E-3, E-4, E-9, F-4, F-15, F-16, F-18, F-22, F-106, F-111, F-117, G-7, H-1, H-53, H-60, Unknown, O-2, ORMI, R-1, R-71, T-1, T-3, T-37, T-38, T-39, T-41, T-43, U-1, U-2.

APPENDIX B

STATISTICAL ANALYSIS

We examined a series of aircraft mishap trends for the last four years. Specific analyses included:

- Overall Class A, B, and C mishaps

- Maintenance related Class A, B, and C mishaps by:
  - Causal factors
  - Aircraft subsystems
  - Weapon systems

Specific trend analyses were related to flying hours where appropriate to remove operations tempo as a potential contributing cause of changing numbers of mishaps.

The Air Force Safety Center Data Operations and Analysis Division provided the data for this study. Available data included counts by fiscal year (FY93 to present) of various categories of mishaps. Subsystem data by aircraft was not available.

Tables 1-4 show overall mishap rates (per 100,000 flying hours) and corresponding maintenance-related (MNX) mishap rates (Class A, B, and C combined) for the most frequently observed reasons for failure, subsystems, and aircraft types.

Summary	FY93	FY94	FY95	FY96
All Class ABC	42.60	47.11	42.25	41.90
All Class A	6.29	6.74	6.27	5.48
MNX Class ABC	5.07	4.92	4.51	4.33
MNX Class A	0.44	0.44	0.36	0.65
MNX Class B	0.08	0.04	0.32	0.05

Table 1 - Mishaps per 100,000 Flying Hours

Reasons	FY93	FY94	FY95	FY96
Complacency	0.83	1.64	1.76	1.66
Discipline	0.71	0.49	0.27	0.28
Judgment	0.67	0.27	0.18	0.18
Part	0.28	0.35	0.36	0.46
Proficiency	0.48	0.18	0.23	0.18
Publication	0.12	0.40	0.41	0.46
Unknown/Other	1.98	1.60	1.31	1.11

Table 2 - Maintenance Mishaps per 100,000 flying hours by Reason

Subsystem	FY93	FY94	FY95	FY96
Structure	0.63	0.31	0.14	0.00
Electrical	0.20	0.13	0.23	0.14
Engine	1.74	2.57	2.17	2.81
Flight Control	0.63	0.35	0.09	0.37
Landing Gear	0.71	0.66	0.81	0.14
Other Subsystems	1.15	0.84	1.08	0.92

Table 3 - Maintenance Mishaps per 100,000 flying hours by Subsystem

Aircraft	FY93	FY94	FY95	FY96
A-10	4.35	5.03	2.53	1.63
C-5	2.56	17.83	0.00	0.00
C-130	3.67	1.43	0.71	0.68
C-135	0.81	1.82	2.73	0.93
C-141	5.41	0.00	0.00	3.41
F-15	16.09	8.56	11.13	13.45
F-16	4.61	4.49	2.85	2.14
F-111	6.53	13.26	23.32	0.00
T-37	3.89	7.25	8.93	10.41
T-38	4.44	3.09	9.03	10.45
Other Aircraft (22)	4.57	5.02	4.78	3.63

Table 4 - Maintenance Mishaps per 100,000 flying hours by Aircraft Type

Slight differences in yearly totals were a result of data coming from three different files. The differences represent only 3 or 4 mishaps out of over 500 and did not affect results. With these data, we identified specific categories as having a significant upward or downward trend to a 95% confidence level by fitting a line to the each category's annual data, and then applying appropriate statistical tests to determine if the line's slope significantly differed from zero. Since our analysis was based on an extremely small sample size (4data points), the reader should use caution in interpreting the results. Findings include:

- Overall maintenance mishaps show a decreasing trend.
- Categories of Discipline, Other/Unknown Reasons, Structural, and F-16 show a decreasing trend.
- Categories of Part and T-37 show an increasing trend.
- No other categories showed significantly changing trends.

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13. ABSTRACT (Maximum 200 Words)

During the LGM Conference of 22 - 23 Jan 97, MAJCOM LGMs expressed concerns with the possibility of problems with discipline and compliance. An independent study was recommended to determine the validity of their concerns. HQ USAF/ILM requested the AFLMA review Class A through Class C mishaps from the last three years and report on causal factors, sub-systems, and year to year comparisons.

The Air Force Safety Center Data Operations and Analysis Division provided the data for this study. We identified specific categories as having a significant trend by applying appropriate statistical tests. However, since our analysis was based on an extremely small sample size, the should use caution in interpreting the results. Results include:

· Overall maintenance mishaps show a decreasing trend.
· Categories of Discipline, Other/Unknown Reasons, Structural, and F-16 show a decreasing trend.
· Categories of Part and T-37 show an increasing trend.
· No other categories showed significantly changing trends.

In summary, we find the evidence does not support the perception that there is a problem with maintenance compliance and discipline.

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